Combination of surface engineering and FTIR spectromicroscopy for development of a cell-based biosensor on Au-SiO_2 platforms

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A novel surface engineering approach was developed to fabricate addressable arrays of multiple and/or single cells with high precision, selectivity, reproducibility, and long-term cell selectivity. First, photolithography and surface engineering were combined to pattern microarrays of cell-adhesive proteins on gold electrodes to mediate cell adhesion. The versatility of this approach for immobilization of various proteins on different types of gold patterns was characterized by florescence microscopy and ToF-SIMS. Optical-DIC microscopy illustrated the selective attachment of various cells on protein-patterned platforms. Next, a new surface treatment protocol was introduced to improve the cell selectivity via modulating the silicon oxide state of the substrate, in which three model surfaces were examined: native oxide, wet oxide, and dry oxide. A short peptide was also immobilized on the dry oxide platform to generate a highly-uniform and fully-spread single-cell patterns. Finally, synchrotron-FTIR spectromicroscopy was used to study bacterial detection by single macrophage cells patterned on the substrate. The developed technique can be readily applied to generate nano-scaled patterns of proteins and peptides. The combination of the single-cell patterning and FTIR spectromicroscopy may remarkably advance the general biosensing technology for *in situ* and noninvasive monitoring of cell responses to analytes.